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ABSTRACT

A review of the research into the second-order factor structure of the 16 Personality Factor Questionnaire (16 PF) indicates disagreement about the number and meaning of the second-order factors. However, repeated analyses of the second-order factor structure have consistently found fewer than the eight factors suggested by Catell (1973) and the Institute for Personality and Ability Testing (IPAT) (1972). This research extended knowledge in this area by investigating the second-order factor structure of the 16 PF and comparing the results to those found in previous studies. The sample consisted of 2,225 individuals who applied to the college of education of a large university who took the 16 PF as part of admissions requirements. Results yielded a four-factor solution, one of the smallest factor solutions yet obtained. These findings are more consistent with previously reported five-factor solutions and the five second-order factors common to five personality questionnaires than with the eight-factor solution of Catell and IPAT. Ten tables present study findings. (Contains 15 references.) (Author/SLD)

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THE SECOND-ORDER FACTOR STRUCTURE OF THE 16 PF: A FOUR FACTOR SOLUTION

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Abstract

A review of the research into the second-order factor structure of the 16 PF indicates contention about the number and meaning of the second-order factors. However, repeated analyses of the second-order factor structure (Allen & Schuerger, 1983; Barrick & Mount, 1991; Krug & Johns, 1986; Krug & Laughlin, 1977; Schuerger & Allen, 1986) has consistently found less than the eight factors forwarded by Cattell (1973) and IPAT (1972). Consequently, the purpose of this research was to extend the knowledge in this area by investigating the second-order factor structure of the 16 PF and compare the results to those found in previous studies.

The results of this investigation yielded a four factor solution, which is one of the smallest, if not the smallest, second-order factor solution yet obtained. These findings are more consistent with previously reported five factor solutions (B) and to the five second-order factors common to five personality questionnaires (Schuerger & Allen, 1986), than to the eight factor solution of Cattell (1973) and IPAT (1970).

The Second-order Factor Structure of the 16PF:

A Four Factor Solution

According to Cattell (1973), second-order factors are operationally factors which emerge from factoring the correlation matrix among the primaries or first-order factors. Further, Cattell (1973) maintains that the most meaningful simple structure results in factors which are oblique. That is, the primary factors are related to each other. Cattell (1973) comments,

> [p]sychologically these second orders - or *secondaries* - tend to be broader and shallower, that is, of lesser variance, than primaries....For the present a second order can best be considered some influence that affects several primaries at once, as a man's age might affect his sensory acuity, metabolic rate. (p. 103)

And,

> [b]ecause the number of source traits is large - at least twenty-five, though only sixteen are perhaps large enough in influence to be put into test instrument scales - some practitioners have suggested that we work, alternatively, with second order factors....One treads on complex technical matters here but, in a few words, it may be said that although primary personality factors are distinct, they are not mutually uncorrelated.... Consequently, one can make a correlation matrix among them...and find factors among factors. (p. 101)

Based upon content, criterion associations, and relations to objective test factors, eight second-order (also known as higher order) factors were identified (Cattell, 1973).

Exvia - invia. This factor is related to the common terms of Extraversion and introversion. High exvia is associated with willingness to risk decisions on

vague data, quick judgments, higher optimism, freedom from depressive inhibition over mistakes, and more disregard for rules (Cattell, 1973).

Anxiety. According to Cattell (1973), this factor is a function and outcome of general drive strength, degree of drive denial, instability of ego control, cognitive uncertainty, integration, guilt proneness, and sympathetic reactivity to threat.

Cortertia – pathemia. Pathemia (–) relates to a relaxed and indulgent life of feeling (Cattell, 1973). This individual is warm, sentimental, daydreams, and is sensitive in emotions (tendency toward melancholy). In contrast, the individual scoring high on this factor (cortertia) is alert, realistic, feelings cool and under control, and their main concern is practical effectiveness (Cattell, 1973).

Independence – subduedness. According to Cattell (1973), the independence pole of this factor is associated with perceptual field independence, a reduced likelihood of erroneous reactions under complex instructions, high severity of judgment, logical consistency of attitudes, needing less sleep, making social contacts, and rejection of sexual constraint. The opposite pole, subduedness, is associated with individuals who have lost close relatives and friends and have more devotion to home.

Foxiness or discreetness – good natured security. Cattell (1973) comments that this factor's discreetness pole generally seems to be "a set of acquired skills and attachments in social activities with some indications of po[i]se rather than naturalness, and possibly an exploitive use of social skills" (p. 187).

Prodigal subjective idealism – detached realism. This factor is an imaginative interest in idealistic change in relation to subjective goals, as opposed to practical acceptance of existing reality (Cattell, 1973).

Intelligence. This factor appears to factorially the same as its first-order factor (B).

Good upbringing. According to Cattell (1973), this factor is related to good upbringing in morals and manners and personal discipline (exercising control). It has been associated with leadership in groups, experience with bereavement, staying in college, and involvement in church activity.

Cattell (1973) comments that the second-orders were discovered fairly early in the 16 PF research and have been brought to "a high degree of confirmation and precision" (p. 111). In summarizing over 25 studies on the second-order factors, Cattell (1973) provides a summary of the relationship between the secondaries and the primaries (see Table 1 for a synopsis of the major correlations).

Insert Table 1 about here

Less Than Eight Second-order Factors

According to Barrick and Mount (1991), replications of Cattell's work in regards to the eight second-order factors proved generally unsuccessful, and that in each case researchers found that a five-factor model accounted for the data the best. Further, their meta-analysis of the research on the "Big 5" personality factors revealed that while there was general consensus concerning the number of second-order factors, there has been some disagreement about their precise names and meanings. Their analysis indicated the following "big five" personality factors: Extraversion/ Introversion (or Surgency); Emotional Stability (or Stability, Emotionality, Neuroticism); Agreeableness (or Likability, Friendliness, Social Conformity, Compliance, Love); Conscientiousness (or

Conformity, Dependability, Will); and Intellect (or Openness to Experience, Creative).

Furthermore, while Krug and Johns' (1986) investigation and validation of the 16 PF's second-order factor structure yielded a seven factor solution, only five factors remain once Factors 6 and 7 are removed because they load on only a single primary scale. These five second-order factors are: Extraversion, Anxiety, Tough Poise, Independence, and Control.

Other researchers have found slightly different results. For example, Allen and Schuerger (1983) factor analyzed subjects' primary factor scores on Cattell's 16 PF using promax and varimax factor rotation. Their findings indicated the existence of seven factors: Anxiety, Exvia, Independence, Control, Cortertia, Intelligence, and Discreetness. These results replicated five of Cattell's eight second-order factors plus two more.

Relatedly, Reuter, Schuerger, and Wallbrown (1985) used hierarchical factor analysis and found seven second-order factors which supports the earlier work of Cattell (1973) and Allen and Schuerger (1983) concerning the second-order factor structure of the 16 PF. Seven second-order factors found were: Ascendancy aspect of Independence, Anxiety, Control, Extraversion, Cortertia (neg.), Experimenting aspect of Independence, and Discreetness. Reuter et al. (1985) concluded by calling for further study of the hierarchical factor structure of the 16 PF for persons considered normal and persons in various clinical subgroups.

Krug and Laughlin (1977) investigated the second-order factor structure of the 16 PF for both normal and pathological personality traits. In regards to the normal personality traits, seven second-order factors were obtained: Extraversion, Anxiety, Tough Poise, Independence, Intelligence, Superego, and Socialization.

Additionally, Krug and John's (1986) cross validation of the 16 PF's second-order factor structure yielded the same seven factor solution as Krug and Laughlin (1977).

Finally, Schuerger and Allen (1986) investigated the second-order factor structure of the 16 PF and four other personality questionnaires: The California Personality Inventory, the Edwards Personal Preference Schedule, the Omnibus Personality Inventory, and the Adjective Check List. Their study confirmed the existence of five to six broad factors spanning the normal personality space, which are linear combinations of the scale scores. Schuerger and Allen (1986) comment,

> arguing for the importance and predominance of those factors as 'entities' which span a broad realm of questionnaires is the striking fact that the extensive prior factorizations of the California Psychological Inventory and the 16 PF, on which our hypothesized scheme is built, have consistently yielded five or six factors...which exhaust the variance in these instruments in the usual factor-analytic sense. (p. 124)

This study was undertaken to confirm or disconfirm the number and identities of the second-order factors of Cattell's 16PF found in earlier studies.

Method

Subjects

The sample consisted of 2,225 individuals who applied to a large Midwestern university's college of education over a three year period and took the 16 PF as part of their admissions' requirements. Slightly less than three-quarters (74.5%) of the sample were women.

Procedures

The principal components method of factor analysis was used in this study. The 16 factors of Cattell's 16 Personality Factor Questionnaire were intercorrelated and the correlation matrix was submitted to SAS for a principal components analysis. In the principal components method, the first factor extracted accounts for the most variance, the second factor for the next greatest variance, and so on. In this case, the factors generated are second-order factors, since Cattell developed the 16 PF (and the original 16 factors) using factor analytic techniques. Factoring was stopped based on the rule of extracting factors until an eigenvalue of less than 1 is obtained.

Orthogonal factor rotation was used in this study. The orthogonal factor solution rotates factors at 90 degree angles, resulting in factors which are not correlated to each other (orthogonal factors). The orthogonal rotation method used was the Varimax rotation. The Varimax method maximizes the variance accounted for in the columns of the factor matrix (by producing the highest column eigenvalues).

Results

The results of this second-order factor analysis are presented in Tables 2-6. Table 2 shows the factor loadings of the Varimax solution of the principal

component method of factor analysis. Using an eigenvalue of less than 1 as the criterion to stop factoring, four factors were extracted which accounted for 51.25% of the total variance.

Insert Table 2 about here

Factor 1 accounted for 19.06% of the factor variance (eigenvalue 3.0500) and represented a dimension primarily characterized by anxiety (see Table 3).

Insert Table 3 about here

Factor 2 accounted for 13.90% of the factor variance (eigenvalue 2.2233) and represented a second-order dimension of Extraversion (see Table 4).

Insert Table 4 about here

Factor 3 accounted for 10.57% of the factor variance (eigenvalue 1.6910) and represented a second-order dimension of independence (Table 5).

Insert Table 5 about here

Finally, Factor 4 accounted for 7.72% of the factor variance (eigenvalue 1.2358) and represented a dimension primarily characterized by uncontrolled imaginativeness (see Table 6).

Insert Table 6 about here

Discussion

The second-order factor solution in this study did not correspond with the eight factor solution reported by IPAT (1970), Cattell (1973), Allen and Schuerger, and Reuter, Schuerger, and Wallbrown (1985). However, the results were more supportive of the "big five" factor solution (Barrick & Mount, 1991). Results were also somewhat similar to the five broad second-order factors utilized by Schuerger and Allen (1986) in their analysis of the second-order factor structure common to five personality questionnaires and to the five major factors found by Krug and Johns (1986). Furthermore, this supports Zuckerman (1985) who comments that in examining the 16 PF's factor pattern matrix, only four secondary factor scores are reliable across sex and have loadings on more than one of the primary factors.

In regards to the actual factor structure, this study's Anxiety (Factor 1), Extraversion (Factor 3), and to a lesser extent, Independence (Factor 2) and Uncontrolled Imaginativeness (Factor 4) corresponded to four of Allen and Schuerger's (1986) big five factors: Extraversion, Anxiety, Independence, and Control (see Tables 7, 8, 9, and 10). Also, these factors strongly correspond to five of Krug and John's (1986) seven factor solution: Extraversion, Anxiety, Tough Poise, Independence, and Control (see Tables 7, 8, 9, and 10). Comparison to Cattell's (1973) factor solution indicated a correspondence to only two of the eight second-order factors, Extraversion and Anxiety (see Tables 7 and 9).

Insert Tables 7,8,9 & 10 about here

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Table 1

Correlations Between Primaries and Secondaries

Primary Factors	Secondary Factors							
	I	II	III	IV	V	VI	VII	VIII
A	.58		-.25			.28		
B							.67	
C		-.66						
E				.56				
F	.51			.30				-.27
G								.67
H	.50	-.38			.34			
I			-.73					
L		54		.40				
M			-.47					
N					.63			
O		.78						
Q1						.56		
Q2	-.65							
Q3		-.43						.47
Q4		.80						

Note. Values less than .20 have been omitted.

Table 2

Factor Loadings for Varimax Solution
(N=2,225)

	Factors				
Var.	1	2	3	4	Commun. Est.
A	-.1004	.6939	-.1276	.0107	.5079
B	-.1028	-.1024	.0713	.4721	.2490
C	-.7766	.0135	.0607	.0500	.6276
E	.0517	.3159	.6765	.0773	.5661
F	.0200	.6607	.3849	.0328	.5862
G	-.2127	.1345	-.1910	-.5751	.4305
H	-.3745	.6399	.3618	-.0413	.6823
I	.0558	.2860	-.4016	.5262	.5230
L	.5724	.0816	.3546	-.1377	.4790
M	-.2662	-.0051	.0891	.6472	.4977
N	-.0030	-.0647	-.5597	-.1981	.3566
O	.7449	-.1093	-.1361	-.1048	.5964
Q1	-.0220	-.1291	.6114	.0463	.3931
Q2	.0469	-.6681	.0635	.1996	.4924
Q3	-.5615	.0200	-.2127	-.4470	.5608
Q4	.8007	-.0983	-.0260	-.0052	.6515

Table 3

Factor 1 (Anxiety)

Factor Name		Loading
C	Emotional Stability/Ego Strength/Calm	-.7762
L	Protension/Suspecting/Irritable	.5724
O	Guilt Proneness/Anxious	.7449
Q3	High Self-Sentiment/Socially Precise/Controlled	-.5615
Q4	High Ergic Tension/Fretful	.8007

Table 4

Factor 2 (Extraversion)

Factor Name		Loading
A	Affectothymia/Warmth/Outgoing	.6939
F	Surgency/Cheerfulness/Heedless	.6607
H	Parmia/Adventurous/Socially Bold	.6399
Q2	Self-Sufficiency/Prefers Own Decisions	-.6681

Table 5

Factor 3 (Independence)

Factor Name		Loading
E	Dominance/Assertive/Rebellious	.6765
I	Sensitive/Dependent/Imaginative	-.4016
N	Shrewdness/Socially Aware	-.5597
Q1	Radicalism/Experimenting/Free Thinking	.6114

Table 6

Factor 4 (Uncontrolled Imaginativeness)

Factor Name		Loading
B	High Intelligence/Insightful	.4721
G	Superego Strength/Responsible/ Emotionally Disciplined	-.5751
I	Sensitive/Dependent/Imaginative	.5262
M	Autia/Imaginative/Absorbed in Ideas	.6472
Q3	High Self-Sentiment/Socially Precise/Controlled	-.4470

Table 7

Anxiety

This Study	Schuerger & Allen	Cattell	Krug & Johns
C	C	C	C
H	L	H	H
L	O	L	L
O	Q3	O	O
Q3	Q4	Q3	Q3
Q4		Q4	Q4

Table 8

Independence

This Study	Schuerger & Allen	Krug & Johns
E	E	E
I	M	H
N	Q1	L
Q1	Q2	Q1
		Q2

Table 9

Extraversion

This Study	Schuerger & Allen	Cattell	Krug & Johns
A	A	A	A
F	F	F	F
H	H	H	H
Q2	Q2	Q2	Q2

Table 10

Uncontrolled Imaginativeness/Control

This Study	Schuerger & Allen	Krug & Johns
B	G	G (Control)
G	Q3	I (Tough Poise)
I		M (Tough Poise)
M		A (Tough Poise)
Q3		Q1 (Tough Poise)